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ROGERS Booster

CONTENTS

Industry News 2
The New Heaterless Vacuum Tube 3
More on Oscilloscope Waveforms 4
Tips for Technicians 6
What's New in Tubes? 7

A MAGAZINE DEVOTED TO THE INTERESTS OF RADIO—TV TECHNICIANS IN CANADA

INDUSTRY NEWS

Five Year Plan, Five Years Late — The Soviets have announced the production of two types of color TV sets, each using different picture tubes. The first set will have three kinescopes, one for each of the primary colors, which will project a composite picture on the screen. The second has a single kinescope that emits three beams in the manner we are familiar with. Color broadcasting is supposed to begin later this year using a compatible system.

Optimist or Pessimist? — (It all depends on your point of view.) Speaking to a Chicago press conference, the president of a large U.S. manufacturer (again with a Canadian subsidiary) predicted trouble-free TV receivers within five years. Transistors, he said, would do the trick. Other predictions: (a) Transistorized TV sets will be on the market in one or two years. (b) FM for automobiles will be solved within the next couple of years. Present limitations involve range and interference from the motor.

Printed-Circuit Problems — This was the subject covered by a seminar held by the Institute of Printed Circuits last month in New York. Difficulties of service technicians in pinpointing component failures was listed as the chief complaint. The second was accessibility and the third was conductor lift during servicing. Among other things, the manufacturers replied that service technicians had become accustomed to one method of servicing and did not want to change; that printed circuits require a new technique and new tools. There are always two sides to a story and so this may be a hint to your Booster to return to the subject again.

Thermoelectrics — In spite of the fact that the thermocouple has been with us for generations, the hottest subject in the technical journals at the time of writing is thermoelectrics. Scores of firms are crowding into the field in anticipation of technological changes that may dwarf those brought about by the transistor. Thermoelectricity involves the direct interconversion of heat and electricity. Carrier transport properties of the material itself transfer energy and no moving parts are necessary. What this could mean to the electronics field can only be imagined. Watch your Booster for further details.

Those Japanese Transistors — As a follow-up on a news item in our last issue, it is interesting to note that the Ministry of International Trade and Industry in Tokyo has approved the export of 50,000 transistors to a U.S. firm with a Canadian subsidiary. One stipulation was a fixed price and 100% cash payment whereas the Japanese manufacturer wished to sell at a lower price with a 70% down payment.

Front Cover

Watch for a special envelope coming your way soon with good news of something new from Rogers . . . something that will help you in your work.

Back Cover

One of the most versatile tubes on the market today is the Rogers 5AR4 Special Quality Rectifier.

The New Heaterless Vacuum Tube

The old vacuum tube never dies! Just when we think that the transistor and similar devices are going to push it off the shelf, something new develops. One of the big drawbacks of the tube has always been the relatively heavy current drain of the heater, not only in battery-operated radio receivers but in a.c. operated TV sets. Transistors, of course, have given us some quite satisfactory small portable radios but the development of a truly portable transistorized TV set has run into some snags. Perhaps the new cold-cathode vacuum tube will solve some of the problems.

This tube was demonstrated recently by an American company and the U.S. Signal Corps and is claimed to be the first major breakthrough in tube design in 30 years. Externally, the tube looks quite conventional because it is housed in a common type of envelope. Internally, however, it differs to some extent.

The tube elements and the basic circuit are shown in Figure 1 and technicians who were in business in the 1930's may recognize it as the space-charge circuit of those days that used tetrodes like the type 49.

It is the use of a cold-cathode, of course, that prompts the use of the term "major breakthrough". The story behind it is that in 1952 Dr. Dobischek of the Signal Corps was bombarding a thin layer of magnesium oxide with an electron beam to produce secondary emission. His first discovery was that the emission was increased by maintaining a strong positive field near the surface of the layer. The second discovery was that, if the beam were turned off, the magnesium oxide continued to emit under the influence of the positive field.

It is only natural that the application of this phenomenon to the vacuum tube would suggest itself and experiments were begun immediately to improve methods of preparing and applying the oxide to the conventional nickel sleeve found in other cathodes. (As usual, the chief problem was in finding a method that could be applied to mass production.) They finally came up with a sprayed-on coating of porous magnesium oxide.

The theory of operation does not appear to be too clear at the time this is being written. Apparently, when the surface is bombarded to produce secondary emission, it becomes highly positive. It is possible that this high charge draws electrons from the interior and an avalanche effect occurs, similar to that in some semiconductor devices. In any case, a blue glow appears and, with the bombarding beam cut off, the emission continues until the external circuit is broken.

Disadvantages — Our readers have probably already realized the chief drawback of the new tube — the emission is not self-starting. Fortunately this is not too serious because very little is required to start the tube. In the particular type that has been demonstrated, a tiny filament was lighted for less than a second by current from the B-supply. The filament is so placed that the electrons it emits will strike the cathode. There are other possibilities too. Two suggested methods are the addition of a little radioactive material to the cathode oxide to make it self-starting or some photo-emissive substance so that ambient light would start the action.

(Cont'd on Page 6)

More on Oscilloscope Waveforms

In our last issue we gave several examples of a-c waveforms with certain percentages of second harmonic distortion. Before continuing we would like to stress the fact that such waveforms may result from two situations. Let us suppose we have a perfect microphone and a perfect amplifier. We also have two musical instruments that produce pure musical notes — sine waveforms. The first instrument begins at a frequency of 1000 cycles and the output from the amplifier is a pure sine wave of the same frequency. Now the second instrument begins to produce a 2000-cycle sound wave at, say, 20% the amplitude of the first. The resultant output from the amplifier will resemble one of the waveforms shown previously.

Since both frequencies were supposed to be present and in those proportions, you have a real hi-fi set-up. (Of course we know that a device does not have to be that perfect to be called hi-fi these days but so far no one has answered the question "how hi is fi?".)

Now let us play the first musical instrument alone but substitute an amplifier that distorts the waveform because of overload on a tube, saturation in an iron-cored inductor or misadjusted bias, etc. The output waveform could well look like one of those already shown. But only one frequency is supposed to be present now and, although it sounds the same, the output is distorted. The point to be made here is that, when testing any device for distortion, both the input and output waveforms should be checked.

One other thing we should note before proceeding: The waveforms shown previously were not symmetrical; which is to say that the positive half-cycle is not an exact duplicate of the negative. This is typical of all even-harmonic distortion. As we shall see in a moment, odd harmonics show a different pattern.

Third Harmonic Distortion — This condition can arise in several ways. A single tube operated Class A and overdriven will cause a flattening at the top of each half cycle due to saturation on the positive and an approach to cutoff on the negative. A further step comes when two tubes are operated in push-pull, each conducting on its own positive half-cycles. If overdriven, due to a sudden increase in secondary emission, each will have a dip in the peak of its swing. This is shown in Figure 1 where the distortion represents about 20% third harmonic content.

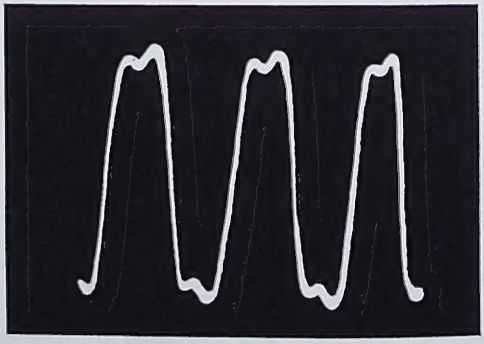


FIG. 1

A more severe case is shown in Figure 2 where the third harmonic content is about 40%.

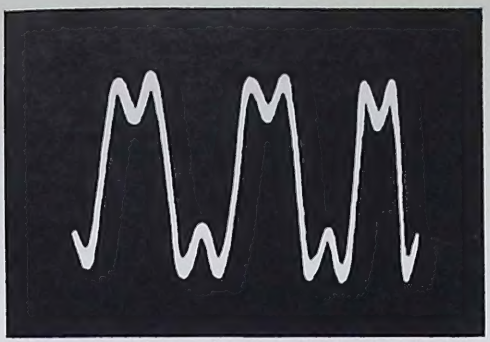


FIG. 2

But wait! Before we get the impression that all third harmonic distortion looks like this, let us remember that phase is also a factor. If we were actually mixing two sine waves of 1000 and 3000 cycles, we could shift the phase so that a peak instead of a dip occurs. Similarly, an amplifier could be operated in such a manner as to produce a severe peak on each half-cycle so that we have a situation equivalent to the injection of a third-harmonic sine wave.

This is shown in Figure 3 where the third harmonic content is again 40%.

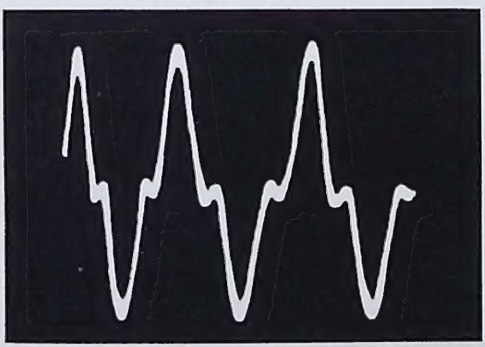


FIG. 3

Now study Figures 1, 2 and 3 again. The most important thing to observe is that these waveforms are symmetrical — each half cycle being a mirror-like replica of the preceding. This is typical of all odd-harmonic distortion.

Back to Even Harmonics Again — Now that you have certain patterns fixed in your mind, look at Figure 4. Viewed separately, the upper and lower halves look very familiar — but don't let them fool you. If you stop and consider you will realize that the pattern is not symmetrical and so could not represent any single odd-harmonic component.

Actually, Figure 4 shows a sine wave mixed with 30% of a fourth harmonic.

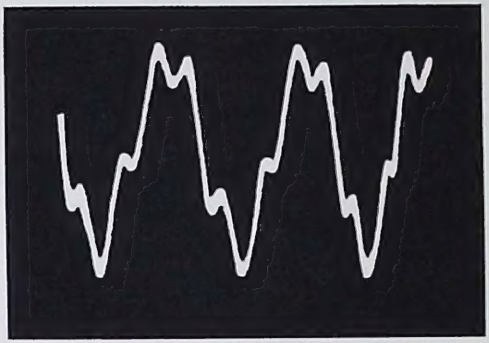


FIG. 4

Conclusion — From the foregoing it should be evident that the proper manipulation of the oscilloscope calls for some theoretical knowledge and some practical experience. The need for the latter cannot be over-emphasized. We will return to this subject with more waveforms and some practical suggestions for experimental work.

$5 Send us your latest original service hint. If previously unpublished and found suitable for publication, you will receive a cheque for $5.00.

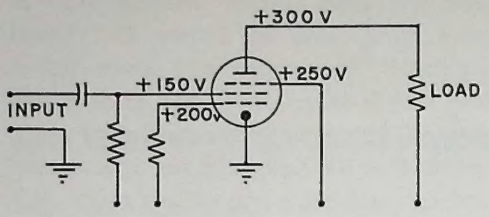


FIG. 1

Another disadvantage will be observed in Figure 1; that is, the rather high operating voltage required – at least 300 volts. This has already been reduced to some extent in certain types and it is hoped that it can be reduced to not more than 180 volts. This is still high for some applications; for example, there is the hybrid car receiver in which a transistor is used in the output stage to permit 12-volt operation.

Advantages – The greatest advantage, of course, is that of power economy because, in many applications, the heater gobbles up most of the energy used by the tube. Secondly, the fact that the tube starts almost instantly is a big advantage in some applications.

Thirdly, the cathode seems to have an indefinite life, some having been run for 14,000 hours without any sign of weakening.

A Typical Circuit – The only type so far constructed is the one demonstrated recently – a power amplifier. Its use in an audio output stage is shown in Figure 2. Note particularly the starter button. When this is pressed momentarily, the plate

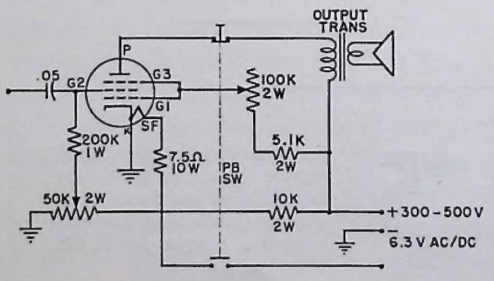


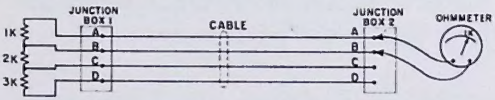
FIG. 2

circuit is broken and the circuit to the tiny filament is closed. The button is spring-loaded so that, as soon as it is released, the plate circuit is closed again. The fraction of a second that elapses between the filament and the closing of the plate circuit is not important because G1 is an emission-sustaining grid.

The Future – This new type of tube will not go on the market until a complete line has been worked out but that may not take too long.

Meanwhile development is proceeding on a cold-cathode gun for cathode-ray tubes which should make a genuine portable TV set more a reality. Further suggestions are for its use in flat "picture-on-the-wall" display devices for TV and radar and in amplifier tubes using secondary emission multiplication.

TIPS FOR TECHNICIANS



Tracing Cable Wires – Let us suppose we have a cable in which the wires are not color-coded and the length is such that both ends cannot be reached simultaneously with an ohmmeter. The leads can still be traced if resistors are connected across one end as shown in the accompanying illustration. Search until a reading of 1 K is obtained. We now have wires A and B but do not know which is which. Remove ONE ohmmeter lead and try another wire. If the reading is 2 K, then we have wire C and the other lead must be connected to B. (If the reading is 3 K, we still have wire C but the other lead must be connected to A.) Apply this same reasoning to find wire D. This method is particularly helpful when only one person is on the job.

BRIAN HOFSTETTER, Kitchener, Ont.

What's New in Tubes?

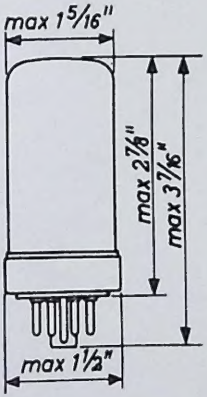
Products mentioned in the series "What's New in Tubes?" are available through Rogers distributors across Canada. Complete data sheets or further information may be obtained by writing direct to Rogers Electronic Tubes and Components, Technical Information Service, 116 Vanderhoof Avenue, Toronto 17, Ont.

Rogers 5AR4 — In the selection of a rectifier tube for a radio receiver or a hi-fi set the circuit designer must consider between a directly and indirectly heated rectifier tube. The directly heated tube is likely to cost less but against this must be considered the following factors: The directly heated rectifier tube develops its B + voltage before the other tubes are warm; this requires the use of higher-voltage-rated filter capacitors, as there is initially no load on the power supply. Also when the full plate and screen voltages are applied to the other tubes before the cathodes of the other tubes have reached full emission, the cathode life can be severely shortened. The plate to cathode voltage drop is lower for the indirectly heated rectifier which allows the use of a lower cost power transformer. The indirectly heated power rectifier will have a longer useful life due to its greater reserve of emission.

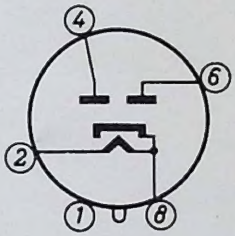
The Rogers 5AR4 is an indirectly heated rectifier with ratings comparing favourably with earlier types. The table compares it with the closest known type, the 5V4G (which is equivalent to the 83V, except for the latter's use of the four-pin base). It can be seen that for the modern more powerful radio or audio amplifier the 5AR4 is superior to the 5V4G. Also the 5AR4 has a slightly lower plate-to-cathode drop, and so replacing the 5V4G with the 5AR4 (always permissible), will raise the B + voltage. The pin connections are the same on both tubes.

The 5AR4 is identical in all respects to the European tube GZ34.

TUBE OUTLINE



BOTTOM VIEW OF BASE

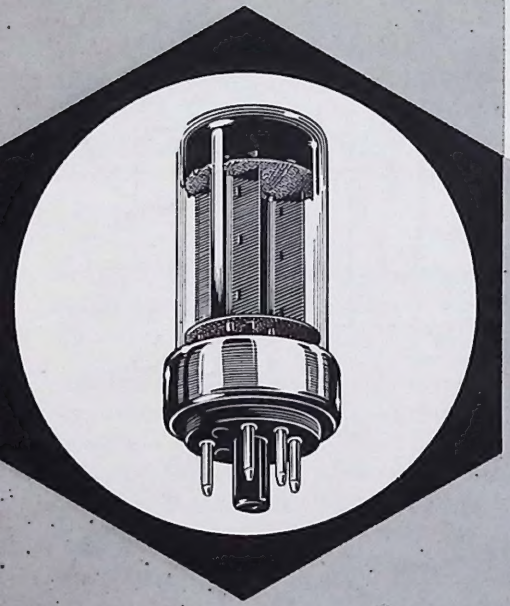


1. Internally connected
2. Heater
4. Plate No. 1
6. Plate No. 2
8. Heater, cathode

	5AR4	5V4G	
Heater: Voltage:	5.0	5.0	V
Current:	1.9	2.0	A
Maximum Ratings (Design Centre Values):			
Peak Inverse Plate Voltage:	1500	1400	V
Peak Plate Current, Each Plate:	750	525	mA
Characteristics and Typical Operation — Full Wave Rectifier			
Capacitor Input to Filter:			
AC Voltage per Plate (RMS):	400	375	Volts max.
DC Output Current:	250	175	mA max.
Effective Plate Supply Impedance per Plate:	100	100	Ohms min.
DC Output Voltage at Filter Input:	400		V dc
Choke Input to Filter:			
AC Voltage per Plate (RMS):	550	500	Volts max.
DC Output Current:	225	175	mA max.
Input Choke:	10	4	henries min.
DC Output Voltage at Filter Input:	460	-	V dc.

*Rogers 5AR4 Special Quality** general purpose rectifier is a universal replacement for numerous commonly used 5 volt rectifiers. Designed for efficiency and long life, the 5AR4 is of pressed glass base construction. Other features of the tube include a 5 volt 1.9 amp. heater; a peak inverse voltage of 1500 and a maximum r.m.s. current output of 250 mA. The 5AR4 has a low voltage drop ensuring maximum output. Write for full details on this special quality rectifier.

**Rogers Special Quality tubes are finding more and more applications in all types of electronic equipment. For greater reliability and lower maintenance costs, specify Rogers tubes.*



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